THE BULLETIN
OF THE
AMERICAN CERAMIC SOCIETY

A MONTHLY PUBLICATION DEVOTED
TO THE PROMOTION OF CERAMIC
EDUCATION AND TECHNOLOGY

JULY • 1933

VOLUME 12 NUMBER 7

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of Technical, Scientific, and Art Questions, and
Promotion of Coöperative Research

Vol. 12 July, 1933 No. 7

THE BULLETIN OF THE AMERICAN CERAMIC SOCIETY

This is the 139th issuance of *The Bulletin*. It is now in a more readable format and under its own cover to achieve distinction and to obtain broader contacts. This issue is Volume 12, Number 7.

(1) Object The purpose of every means or tool employed by the Society is limited to the purposes dictated in its Constitution and By-Laws—that of promoting ceramic arts and science.

The three steps essential to progress are creating, recording, and applying information. To these three steps in ceramic art and science, this Society is exclusively devoted.

(2) Methods and Means The means of recording are provided by the *Journal* and *Abstracts*.

The creating and applying of information—"education and technology"—are the essential activities on which the members of the Society are engaged. To the promotion of these activities *The Bulletin* is devoted.

(3) Unison in Activities Sought Included in this purpose of *The Bulletin* is the obtaining of the most effective and economical coöperation in fact finding and information applying. *The Bulletin* is the medium for setting forth problems on which both fundamental and applied information is desired. Through *The Bulletin* the several committees, research agencies, and educational institutions will set forth their programs, obtain support, secure collaboration, and make certain that they are working on the problems essential to the ceramic industries, and that there are being developed the needed fundamental data and facts.

Of importance and of positive value, *The Bulletin* has made and will continue to make evident the close relationship and the sameness in the fundamentals underlying the clay, glass, and vitreous enamel industries. Ceramics is the art and science of producing by fire useful articles from silicate materials: clay, glass, and enamels. Whether the product is 100% silica or consists of oxides other than silica in predominance, the fundamental and fabricating problems are ceramic in their kinship. Therefore it is essential to the progress in any of the lines of ceramic ware development that the investigators in each shall be mutually informed of problems and methods and the results obtained in each of these three apparently distinct (from standpoint of product only) ceramic fields.

(4) Ceramic Ware Promotion The members of the American Ceramic Society are engaged in developing and promoting ceramic products, often in collaboration with members of other societies and associations. These activities are being promoted and unison in efforts obtained through the columns of *The Bulletin*.

Materials, equipment, and processes are as essential to quality production as are compositions. Standards, tolerances, and controls are the tasks of the plant technologists. These are subjects of investigations and reports by individuals and by groups.

With the new National Industrial Recovery Act there will be a more intense study and a greater collaboration on materials, equipment, and processes. These are tasks that must be rendered "enroute," for progress and development in production are of increasing daily importance under the Recovery Act.

(5) Ceramic Education Ceramic education, or preparation for service in the ceramic industries and research laboratories, is of vital concern to all ceramists. It costs tax payers a large sum annually to maintain ceramic colleges and schools. It costs the employers a large sum to orient the graduate before he can render effective service. The "schooling" of the prospective ceramic technologist should con-

cern the ceramic plant executives even more than it does the instructors.

The most effective schemes for ceramic education will be developed by collaboration of plant and school men with *The Bulletin* as their medium.

(6) News Items News items that concern ceramic education, investigations, plant applications, and product development will continue to be given in *The Bulletin*. These include items on personnel and work programs of research and educational institutions, and of societies interested in ceramics. Such news items serve to keep all interested persons in progressive step.

(7) Why This New Format A more readable publication and a wider distribution without change in scope are the purposes of issuing *The Bulletin* under its own cover separate from the *Journal* and *Ceramic Abstracts*.

THE BASIC STRUCTURE OF THE CERAMIC INDUSTRIES[1]

By Albert Victor Bleininger

It is indeed an agreeable privilege to return again to this beautiful college and to take part in the dedication of the fine new structure which the State of New York has built and set apart for service to the Commonwealth in the field of ceramics. It is eminently proper that such a building be erected here since this college was the second in the United States to offer instruction in ceramics and has behind it a fine record of achievement.

(1) Definition of Ceramics Those of us whose activity lies in this field have become quite accustomed to hear requests for the definition of the word "ceramic," and it is an unusual word. Without going into the etymology of the word, suffice it to say that it is from the Greek, *Keramos*. In the modern sense it has acquired a meaning different from that to be found in the dictionaries even of recent dates. In general, it is understood to refer to the various products fabricated from earthy and other rocks through the agency of fire or heat. In this broad sense, the term "ceramic" might be applied to a large part of the nonmetallic industries which concern themselves chiefly with the inorganic oxides, in distinction from the metal industries in which the elementary metals and their alloys are of principal interest.

(2) Vastness of Natural Ceramic Materials Based on this conception and knowing that the earth's lithosphere has an average composition, according to Dr. Clarke, of 59.79% silica, 14.93 alumina, 5.96 iron oxides, 4.82 calcium oxide, 3.98 magnesium oxide, 3.28 sodium oxide, 2.96 potassium oxide, and smaller percentages of many other oxides, we are not surprised to find that such rocks and minerals as the clays, quartzes and sandstones, feldspars, limestones, steatites, and many more, occurring in vast quantities, supply the raw materials of the ceramic industries. These minerals and their aggregates thus form the basis of the industrial field with which we are dealing.

(3) Ceramic Industries The ceramic industries, in a rough way, may be collected under the general headings of the clay, glass, enameled metals, and the cement industries.

The clay industries may be subdivided into three large divisions, the structural, the pottery, and the refractories industries, each of which has numerous ramifications.

In the structural group we find a large number of products, from the many kinds of brick and sanitary products to artistic tile and architectural terra cotta. In the field of pottery, in which your Dr. Binns occupies so prominent a place, we again have numerous subdivisions, ranging from stoneware to electrical insulators and the most exquisite china and porcelain.

In the refractories division we find products of enormous importance to the metallurgical industries, to gas and coke production, power plants, the fusion of glass, and innumerable other applications. It is not often realized that without the highly heat-resisting and insulating refractory materials these basic industrial activities would be paralyzed. It would be quite difficult to imagine a blast furnace or any other high-temperature operation functioning without the ceramic lining which is so essential.

To the three large divisions just mentioned

[1] Dedicatory address, New York State College of Ceramics, Alfred University, Alfred, N. Y., June 12, 1933.

must be added some highly specialized industries of which the manufacture of grinding wheels is a fine example. Without this important product the modern precision grinding of the automotive industry would hardly be feasible, to say nothing of hundreds of other grinding and cutting operations.

Coming now to the glass industry we also find it to be a complex group. We hardly need to emphasize its enormous importance. How could we vision modern life without the electric lamp, without window or plate glass, without the technical and scientific apparatus made from glass, and the thousands of useful articles made from this interesting substance?

You are very fortunate in having close to you a remarkable industrial institution which has brought the application of science, art, and technology to the highest point of development, the Corning Glass Works. All of us are exceedingly proud of this great American enterprise.

In the industries which concern themselves with the application of enamels to metals we really have a relation of the glass industry. In such familiar examples as the bath tub, the electrical refrigerator, and the modern stove we find steel or cast iron coated with vitreous enamels. This application of glass to metal is being done with much skill and results in a type of protective finish which is remarkably attractive.

Finally, in the field of cements, the chief product is Portland cement which dominates so large a part of all construction and which is indispensable to the civilization of today. This industry is based on reactions which take place between clay and limestone and result in the formation of basic silicates of lime which are in contrast to the acid silicates of the clay industries.

(4) Comparative Values of the Ceramic Industries

Let us now examine these industries with reference to their position among the industries of the nation. We shall consider them from the standpoint of the usual measuring stick, their production values in dollars, and also from a more unusual point of view, their true economic relation to the structure of our country.

As has been said, the ceramic industries belong to the large group of the nonmetallic mineral industries. These have shown a steady growth over the metallic industries and in 1930, during the beginning of the depression, they yielded a production estimated to have been $1,013,325,000 as compared with $986,975,000 for the metals and $2,764,500,000 for the fuels. This growth is significant since it has been rapid, and from 1880 to 1929 the production value of the nonmetallic industries has increased 20 times.

Referring more specifically to the ceramic industries we find that in 1929 the total value of the structural clay products was $297,240,000, of the various pottery products $112,019,000, of the glass products $299,717,000, of enameled products $77,730,000, and of Portland cement approximately $255,000,000. The total value of the ceramic products in 1929 exceeded the respectable valuation of one billion dollars. While it is hardly necessary to add that these values are much lower for the years since 1929 it is found that they have held their own better than the metal products. From these figures it appears that the ceramic industries have assumed no mean proportions and that they occupy a prominent place in the industrial scheme of the country.

We shall now consider these industries from a more unusual angle, that of their true position in the economic structure of the nation. It must be recognized that for every ton of metal ore mined the resources of the country have been reduced to this extent since the ore-carrying deposits are definitely limited in size. On the other hand, the ceramic raw materials are practically inexhaustible. Owing to this abundance the intrinsic value of a ton of ceramic material is low, involving chiefly the labor cost of mining it and transportation. If, through the expenditure of more labor and the use of fuel, we convert the raw materials into useful products it is evident that the people of the nation are the chief gainers. We have given needed employment to our citizens, have afforded a market to the fuel industries, have contributed to the business of transportation, and have manufactured articles of permanent value, and all this without diminishing the natural resources of the country to any appreciable extent. At the same time we are given the opportunity to enhance still further the value of some of the products through the application of some form of applied art. If, from a lump of clay worth only a few cents, the craftsman fashions a beautiful piece of pottery, glazes, and fires it, he certainly has increased the value of the crude material enormously.

This unique economic status of the ceramic

industries is not generally realized and appreciated, especially when we consider that the labor cost is the heaviest item of the total cost. But, as is to be expected, this sort of thing operates equally well in other countries. For this reason they are all eager to convert their low-cost ceramic materials, through the use of their own labor, into products which they hope to sell to us. When they succeed in doing so they hurt us chiefly through the displacement of our labor.

(5) Importance of Ceramic Art Coincident with the large use of labor, we must mention at this time the opportunity offered in this field for the worker in applied art. Through the agency of art the product values not only are enhanced to a marked extent and a field of endeavor is opened to artists and artisans but the country and the people are the richer for such products. When Dr. Binns planned the ceramic courses at Alfred University he showed his wisdom by bringing into close proximity the training in art with that in technology. But the full fruition of this plan is in the future when our people shall be more completely educated to desire and demand beautiful things in their daily surroundings.

(6) Ceramic Products Weather Proof The ceramic products have still another bearing on the economic household of the nation. They have the virtue (already being oxides) of being immune to atmospheric oxidation, corrosion, or decay as compared with metals which must be protected through the use of surface coatings or organic materials. The amount of metal lost to us through corrosion rises to astounding figures. We can look to ceramics to supply us with structural materials which defy the decay of time. Again, the ceramic products, having been through fire, can be expected to give that protection which is essential in reducing the large economic waste caused by fires. Coupled with these considerations the immense variety of shape, color, and texture possible in ceramic products offers unique opportunities, not yet fully realized, for the construction of permanent homes and other structures which give full scope to the expression of individual taste. The objection to the recent proposals to standardize the construction of homes lies in the destruction of individual effort and of esthetic values, to say nothing of the question of permanency.

It would seem that all of these economic factors should be evaluated in estimating the place and importance of those industries in the economy of the nation.

(7) Geographic Distribution of Ceramic Industries Viewing the ceramic industries from the standpoint of their general status and their philosophy, or, as we should say now, their psychology, we find many of them connected closely with the deposits of the raw materials they use, such as the clays. They are circumscribed by local environment, the demands of their locality, and the limited distance through which they can ship their goods. Their point of view hence is strongly localized and sometimes they find it difficult to look at questions from a wider angle. The great number of clay deposits has given rise to many plants which during the last 20 years have gradually been reduced in number and replaced by fewer but larger works. Mergers have also taken place but have not been as successful as was hoped. From the very nature of these industries, the low cost of the raw materials, and their wide distribution they will always remain highly competitive. At the same time, it is being realized that mere size does not determine the success of an establishment but that efficient smaller plants with low overhead costs often stand a better chance of survival than their larger competitors. If we read the signs of the times correctly we might predict that huge manufacturing plants and great mergers which have proved themselves to be vulnerable in periods of distress will tend to be replaced by smaller but highly efficient factories located in strategic positions with reference to the markets and transportation.

Other ceramic industries such as the glass and pottery branches are not so strictly confined to their sources of raw materials. Especially in the glass industry large manufacturing establishments which are highly efficient and equipped with automatic or semi-automatic machines yield the bulk of the production. But, with the exception of the glass and cement branches, the ceramic industries have not carried mechanization to such a degree of completeness as has American industry in general. Those who are compelled to face foreign competition may be forced to the use of labor-saving machines which are far from being an unmixed blessing.

(8) Competition of Ceramic Industries While the manufacturers of the heavier products are comparatively free from foreign competition, the makers of pottery and glass products are subject to it in a marked degree. This struggle, of late, has become very fierce. In addition, there is more or less competition between the related industries, as, for instance, between the manufacturers of glass and pottery. And to make the situation more complicated the products of organic chemistry, such as the synthetic resins, have entered the competition with both pottery and glass. It is not too much to say, then, that competitive conditions exist in this field to a very marked degree, and monopolies are virtually impossible.

(9) Need of Ceramic Ware Promotion The systems of distribution of our industries, as a whole, have not been distinguished by their aggressiveness as compared with other fields. Much has been taken for granted and the country at large is not as familiar with ceramic products as it should be. High-pressure salesmanship and extensive advertising have been conspicuous by their absence. While it would hardly be possible to carry on distribution under such pressure as is common in many fields, it can not be denied that the ceramic industries have been over-modest. During the past five years great advances have been made in the quality and appearance of our products but the American public is hardly aware of this. There is still a prejudice in favor of foreign ware which should be met by statements of fact.

(10) Ceramic Technologists Must Develop and Promote At the present time all of the ceramic industries are extremely active in perfecting their processes and creating new products at a rapid rate. The technically trained men are doing their full share of this work but it would be desirable if more of them were engaged in the operation of plants, in research, and in the field of distribution. It is believed that with the release from the present economic distress, or even partially so, the industry will absorb much new technical assistance, since it has learned the lesson of industrial preparedness. New vision, tempered by scientific thought, is the need of these as well as of all other industries as they must meet the conditions of the future. I hope I may be pardoned for touching upon the commercial phases of the subject. But the technical man of today can no longer isolate himself in his laboratory specialty. He must realize that all aspects of industry are of vital moment, involving as they do the livelihood of thousands of workers.

(11) Fundamental Science Concepts in Ceramics The structure of every industry rests upon some scientific foundation. The ceramic industries have been classified as belonging to the chemical industries. This is not the case in the usual acceptance of the term. In ceramics many factors are introduced which depend upon physical manipulations, manual skill, and practice. What chemical reactions take place differ vastly from those of aqueous chemistry since they deal with the action between solid particles at elevated temperatures. We hardly ever have any completed reaction but practically always an arrested one. For instance, in producing porcelain from kaolin, feldspar, and quartz, we can not and must not allow an equilibrium to be reached, since otherwise we should obtain no porcelain. The ceramist, hence, must often grapple alone with his problems because the chemistry of solid particles reacting at high temperature is still largely undeveloped. This makes experience a large factor in dealing with such systems. And how well the master craftsmen have done is amply illustrated by their work which we admire in museums.

Although the chemistry of ceramics is incomplete a great deal has been done in the application of science to this field. What we need, of course, is a great deal more of chemistry and physics. Without the precision measurement of high temperatures, chemical analyses, petrographic and X-ray studies, and the use of many physical tests, we should be unable to control the industrial processes at all adequately. But we are urgently in need of much more knowledge concerning the intimate structure of the many kinds of rocks and minerals as well as of the finished product we make. Through the use of refined methods of attack, especially the X-ray spectrum and optical and other methods, we must penetrate more deeply into the atomic structure of the substance with which we deal. The new world which modern physics and chemistry have opened to us must be explored within our field. We must learn to know, for instance, the atomic structure of glass and the many silicates that concern us.

That even the most common substances are subject to far-reaching changes in structure is well illustrated by such a universally distributed compound as silica, familiar to all of us as quartz, in the form of sand, pebbles, or sand rock. We should hardly expect the atomic structure of quartz to be complicated, and yet it is exceedingly so. When we heat it from atmospheric to high temperatures we subject it to stresses which cause the rearrangement of the electrons with the result that we find silica to exist in no less than eight forms or modifications, each having its own physical properties. These are known as alpha and beta quartz, alpha and beta cristobalite, alpha, beta, and gamma tridymite, and fused quartz glass. These forms of silica have important industrial applications. Thus, if we were to construct a large modern by-product coke oven, costing a million or more dollars, we must be very careful to select a silica refractory which consists essentially of cristobalite. If, by chance, we should use a material deficient in this kind of silica and rather high in quartz we should run a good chance of losing the investment through the gradual breaking down of the complicated oven structure.

If such changes and transformations are met with in the use of such a supposedly simple compound as silica what have we to learn about the complicated systems represented by the many kinds of glass, the porcelains, and the various types of refractories, to say nothing of the infinite variety of the minerals and rocks which abound in nature?

It must be the task of a teaching and research institution specializing in the field of ceramics to contribute its share to the building up of the chemistry and physics of the reactions of solids at high temperatures. This field of research is a most fascinating one since it offers great possibilities for original investigation. The accumulation of basic scientific facts will make it possible for this institution to speak to industry with authority and to help guide it.

(12) Fundamentals in Ceramic Education

Technical education has become part of the basic structure of most industries. Inherently, it must deal with the application of mathematics, physics, and chemistry to some field of engineering or technology. Specialization has become necessary because of the vast expansion of science and, alas, the short span of human life. But there is proper and improper specialization. If it means the concept of a narrow training without a sound foundation in the basic sciences, I say that it is not worth while, and deserves no place in academic education. I pin my faith in the old-fashioned education, the discipline of the sciences, or some other strict régime of mental training as are the classics in the liberal courses. With us it must be science, and it is well to realize that it has emerged from the world confusion of the present day most untouched and free.

(13) Relating Science to Products

Education in ceramics should combine the teaching of the fundamental sciences with the record of accomplishment of previous generations, whether it be the story of Chinese porcelain, the achievement of Luca della Robbia, or the inspiring triumphs of Josiah Wedgwood, together with the presentation of the modern status of our technology. It is a most difficult task to crowd into a four-year curriculum all the subjects clamoring for attention, and it requires the best efforts of the faculty to maintain a proper balance. But this is the business of the college with which we do not presume to meddle. Yet, I like to think of science and its applications as weaving a thread through all the technical courses, whether they deal with the raw materials or the finished products. It would be most desirable also if the curriculum could find time to foster an appreciation of the fine arts as has been the practice of Dr. Binns, and it is to be hoped that gifted young people would continue to devote themselves entirely to the field of applied art.

(14) Ceramic Product Studies

Speaking for the industry, may I be permitted to point out, as has been urged for many years by the Secretary of the American Ceramic Society, R. C. Purdy, that the critical study of the finished commercial products would be highly desirable. It is not too much to say that future merchandizing must receive more and more the attention of trained men so that steady progress and constant improvement in quality is assured. This is especially true today when new, competitive products constantly encroach upon ours, some of which may seem so long established that their makers dream on blissfully until engulfed by the deluge. Today there are no sacred traditions in industry and no one may consider

himself safely entrenched. The germ of a new idea developed in some obscure laboratory may threaten the existence of any industry at any time. It is this condition which will make necessary a much-needed increase in the number of technical men employed by industry and an increased volume of research.

(15) Human Relation Studies There remains another aspect of technical education which should receive mention and this is the realization that every graduate must face certain social obligations especially in dealing with industrial working conditions, community health, and welfare. The problems of the workers can no longer be ignored and the new world we face today demands an attitude entirely dissimilar to that of the indifference of the "good old times." Human values can no longer be neglected as they have been in the past.

The best gift of the college then, it would seem, is that it fill its graduates with the true spirit of science which is humble and willing to serve but at the same time meets the issues of this world fearlessly and without compromise on fundamentals. More will be expected of the young men of this generation than was the case in our day but the distribution of scientific service will be more general. According to their special talents and inclinations your graduates must be distributed along the entire front of the ceramic industries, many of them in production, some in the field of applied art, some in research, and others in marketing. In the last-named field especially, there is need of new blood and fresh ideas.

(16) Research and Education The splendid equipment provided here by the State will serve not only for the technical training of youth, but will yield a valuable by-product in research. It is to be expected that much investigational work will be done here not only in the domain of science proper, but in many directions in which service will be rendered to the State. The development of the nonmetallic resources of New York demands attention along paths which we realize but dimly today. There will be established in the State entirely new industries which will contribute their share to the wealth of the State. This institution will also concern itself with the search for new products and in rendering assistance to existing industries. It is to be expected likewise that service will be rendered in the more efficient utilization of the present as well as of newly developed ceramic products as applied to engineering, architecture, sanitation, power transmission, and especially in the home. The imperial city of New York alone, which makes use of more nonmetallic products than any other municipality in the world, on a much vaster scale and in greater variety, offers a large field for the application of ceramic art and engineering. It is to be expected that much research coming from this College will find fruitful application in the great city. Investigations coöperative between state departments or municipalities and the New York State College of Ceramics are possible avenues of useful service.

Education and research go well together, one helping and inspiring the other, and creating that atmosphere of intellectual activity which makes the college the vital institution it must be to meet the demands of the present time. It is well for students to mature in a college where research is taken for granted.

The investment made by the State of New York in this technical school can be expected to yield ample returns in four directions: first, through the education of the youth of the State in the technology of ceramics; second, through its contributions to basic science and the arts; third, through its economic researches dealing with the raw materials of the state and the development of new industries; and fourth, through coöperation with official bodies and the industries in many and various directions. Surely such possibilities should be productive enough to justify the investment made by the State in providing these facilities.

(17) Advice against Multiplying Ceramic Schools It is to be hoped that the academic work relating to the education in ceramics in the state of New York will remain centralized at this institution. There has been a tendency during the past fifteen years to over-expand in technical education throughout the country and to follow expensive educational fashions. While it is agreed that technical education in ceramics is a good thing there is no need of unreasonable and foolish expansion. After all, even the largest sections of industry have their limits of absorption which must be recognized. While the New York State College of Ceramics, the second oldest institution of its kind in the country, is

firmly established, the fact remains that overproduction even in education is not desirable.

(18) Salutations May I be permitted to congratulate His Excellency, the Governor of New York, the Legislature, the Head of the Department of Education, and the other officers of the State responsible for the erection of this fine building upon the wisdom of their action. May I also be allowed to felicitate Dr. Davis, President of Alfred University, Dr. Binns, and Dr. Holmes upon the realization of their long-cherished dream.

May this structure, dedicated to the education of youth and the advancement of science, endure and continue to serve the State of New York, and with it, the Nation, for many generations.

HOMER LAUGHLIN CHINA COMPANY
NEWELL, WEST VIRGINIA

POSITION TAKEN BY PATENT OFFICE THAT SILICEOUS COMPOSITIONS FIRED TO 1500°F ARE NOT CERAMIC

The Patent Office has taken the position that wares high in silica and fired to 1500°F are not ceramic wares.

On page 335 of the *Journal of the American Ceramic Society*, June, 1928 (Vol. 11, No. 6), there appear the following four paragraphs on the etymology of the word "ceramic":

W. A. OLDFATHER: Ceramic is a transliteration from the Greek adjective *Keramikos* which is derived from *keramos*, a general term designating the product of the potters' art. *Keramos* is used of articles made exclusively or ordinarily out of clay by the process of firing.

E. W. WASHBURN, H. RIES, and A. L. DAY: *Keramos* is related to an older Sanskrit root meaning "to fire" and as used by the Greeks its primary meaning was "fired stuff," that is, the fundamental idea in the word was that of a product obtained through action of fire. It was the process rather than the materials themselves which was the predominant element in meaning and usage by the Greeks.

The ceramic industries are those which manufacture products by the action of heat on materials of an earthy nature in which the oxide of silicon and the compounds thereof (the silicates) predominate.

See also W. A. Oldfather[1] in proof that the derivative of *keramos, keramous*, applies to a worker in glass.

On the front page of the *Journal of the American Ceramic Society* these words have appeared for the past sixteen years, "A Monthly *Journal* Devoted to the Arts and Sciences Related to the Silicate Industries."

The American Ceramic Society has not adopted a definition for the word "ceramic." It may be well that the Society should define this term in accordance with its present-day usage. As shown in the four paragraphs which we have quoted under the etymology of the word "ceramic," there evidently was a broadening of that term, eventually drawing very close to the present-day definitions.

Ceramics might be defined as follows:

"Ceramics is the art and science of producing by fire useful articles from silicate minerals and mixtures."

Since 1894 when Professor Orton started his Department of Ceramics at Ohio State University, ceramics has been taken to include glass and porcelain enamels, as well as clay products. They even extended the definition to include cements, because cements are fired and are dependent in part upon a silicate for its hydraulic qualities. Following the Ohio State University some twenty-two other universities have established ceramic departments with formal courses of instruction, and other universities like the University of Michigan and University of Wisconsin have established ceramic laboratories, each of these institutions having the conception of ceramics as including the clay, the glass, and the enamel products.

Shall not forty years of collegiate practice and thirty-three years established definition by a national society, backed by the etymology of the word "ceramic," be authoritative?

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[1] *Jour. Amer. Ceram. Soc.*, **9** [9], 633 (1926).

PAPERS AND DISCUSSIONS

TIME-STUDY APPLICATION IN THE CERAMIC INDUSTRY*

By C. K. Andrew

ABSTRACT

This paper gives a short description of general time-study practice in the Westinghouse Electric and Manufacturing Company. The standard time system of wage payment, group system, and leveling method of time study are described with examples of their application to filter pressing, pugging, and tunnel-kiln placing.

I. Introduction

Before the advent of modern time study, it was customary to establish incentive rates either by checking past day work performance or simply by making an overall check by the clock. Attention was seldom paid to the elements, and the time-values or piece-work rates on jobs of different sizes in the same class of work were not consistent. The setting of piece-work rates was usually done by a foreman, clerk, or someone burdened with other duties which did not allow sufficient time for proper analysis before the rate was set.

Time values were not guaranteed. If the workmen were able to make unusually high earnings due to careless rate setting, the rate was cut. To prevent rate cutting, the workmen would agree among themselves to restrict production and thus protect the good jobs.

About thirty years ago the Westinghouse Company began to segregate rate setting from other duties by setting up a time-study department. Time values were guaranteed against cutting, with some exceptions, such as method changes and clerical errors. A minimum wage was also guaranteed. A modest time-study department of several men has grown to one of over 150 men in normal times.

After having tried piece work, Halsey Premium, and Gantt Task and Bonus, the "standard time system" was developed and has been in use for fifteen years with highly satisfactory results.

II. Standard Time Studies

The essential features of standard time may be outlined as follows:

(1) Each job or class of job has an hourly rate, which is taken from the adopted wage scale or key sheet of rates.

(2) Standard time for the job is established by time study.

(3) An operator who fails to come up to the standard time gets the hourly rate. As soon as he meets the standard time, he is paid a higher hourly rate fixed in the wage scale. If he does the job in less than the standard time, he is paid for the standard time at the high rate.

The purpose of the management in adopting the standard time system was to provide a high guarantee equal to a fair hourly rate for the job and a relatively moderate incentive bonus. A standard-time rate, if converted into a price per unit, in principle resembles a straight piece rate with a relatively high hourly guarantee. The time standards are guaranteed as long as the conditions of the job remain unchanged.

The Westinghouse Company looks upon time study as a branch of industrial engineering. In addition to installation and administration of incentives, the time-study man's functions include other kinds of work in connection with improvements in methods, selection of personnel, arrangements of equipment, and calculation of labor cost for estimates. For these positions, the Company prefers to employ men with technical training combined with practical experience in its own plants.

III. Elements Involved

Every job, regardless of its size or apparent complexity, consists of a series of very short operations or elements which in themselves are comparatively simple. Some elements may occur but once in a given job while others may occur numerous times. Likewise certain elements are common to all jobs of a particular class of work, some of which remain constant in the time taken, regardless of the size of the piece, and some of which vary due to the nature of the work.

(1) Fatigue Analysis of the elements enables the time-study man to make recommendations to the foreman to utilize the most efficient equipment available with a mini-

* Presented at the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February, 1933 (Management Session). Received February 23, 1933.

mum of lost motion and fatigue. It is vitally important that the fatigue element be reduced and the workman's energy conserved for productive work.

(2) Speed The next step is the selection of the operator. Contrary to popular belief, the workman selected is not necessarily the fastest. If a number of men is available to be studied, most time-study men will practically disregard speed and select one who is most likely to coöperate.

(3) Leveling Method This plant uses the leveling method of time study and, therefore, is not so particular about the speed of the operator. The leveling method of time study enables the time-study man to level the average watch readings of the time study to the speed of the average man. Working conditions, consistency of watch readings, and skill and effort shown by the workman on the time study are the factors which govern the rating of the study.[1]

(4) Formula If element values have been obtained on a class of work, it is a simple matter to construct a formula from which all time values can be set without additional time studies. These data, in addition to being used for setting time values, are also used for estimating new work.

IV. Examples of Time Studies

Filter pressing, pugging, and tunnel-kiln placing may be cited as specific examples of the application of time study, formula construction, and group organization in the ceramic industry.

(1) Filter Pressing Two men operated a battery of four filter presses on day work and the pugging was done by four men also on day work. The pug-mill operators performed the first pugging operation and packed the clay in aging cellars immediately after it was filter-pressed. After it was aged, they cut it out of the cellars and pugged it into blanks for fabricating.

Although the filter presses and pug mills were located side by side, the workmen were in different departments and were supervised by different foremen. When the quality of the ware was affected by inferior clay, it was sometimes difficult to determine who was at fault.

[1] A thorough explanation can be obtained from Lowry, Maynard, and Stegemerten's book, Time and Motion Studies, McGraw-Hill Book Co.

Previous experiences in other lines of industry have proved that the group system overcomes many of the difficulties encountered when a man working individually, looking out for himself alone, and not caring how some trivial action of his would affect the efficiency of his fellow workman. This plan is ideal for group incentives.

The standard time system of payment is extended to group work on principles that do not differ materially from those used in computing individual earnings. Groups vary in size from two or three up to a dozen or more, and ordinarily are made up of employees engaged in closely related work. Each man in the group has his individual hourly rate and standard time rate. The group is in charge of a group leader (a workman, not a supervisor) who makes up the job time slips. These time slips show the total production of the group for a two-week pay period and the number of hours each man in the group worked. The total pay of the group is computed on the basis of hours taken compared with the standard hours allowed for the whole pay period. Each man receives his portion of the total hours worked at his individual hourly rate. If the total allowed hours for work performed in a pay period were 840, and the group worked 700 hours, the efficiency of the group would be 840 divided by 700 which is 1.2 or 120%. If a man had an hourly rate of 50 cents and a standard time rate of 56 cents and worked 75 hours, his earnings for the pay period would be 75 times 1.2 times 56 cents or $50.40.

About twenty time studies were required to obtain accurate element values on the entire operation of filter pressing and pugging. A formula was constructed from the element values which enabled one time-study man to set four hundred and twenty-five values in one and one-half days.

A group of four men was organized with one of the four selected as group leader. The man selected for group leader was chosen because of his knowledge of clay and his potential ability to be able to supervise the group and was given 5 cents per hour additional over his rate. The group was paid only for good ware that came off the hot-press machines, a very small allowance having been made in the time values to take care of clay actually spoiled by the hot-press operators. When an exceptionally large amount of clay was spoiled, due to machine or tool troubles,

the foreman of the department notified the time-study man who made special allowance to the filter-press group. This particular application of time study and group organization effected a savings of approximately $1500 per year.

(2) Tunnel Kiln The greatest single savings to date was effected by the installation of group incentives on tunnel-kiln loading and unloading.

Loading, unloading, ware carrying, car cleaning, and sagger handling are performed by twenty-six men working day work. Some of the ware is delivered to the kiln on a conveyer which runs the entire length of the loading platform about three feet from the edge. The remainder of the ware is delivered on trucks by ware carriers and stored in racks adjacent to the conveyer. Some saggers are delivered by the conveyer, others are stored on the floor as near the cars as possible, and the remainder are obtained from the kiln cars where they had been placed when the ware was unloaded.

The day work performance of this department was above the average and appeared to be very efficient. There was little discontent in spite of the fact that there was a wide range in the hourly rates on the various jobs. The department was supervised by a foreman who had had no previous direct experience with time study. He possessed the average amount of pride in having a crew of good workmen, but was receptive to suggestions to improve the department.

At least one time study was made on practically every man, and time values obtained for every element. Car loading was first studied and final time values were established for six classes of ware. The classes were divided according to the number of pieces placed at one time with special classes for tube hanging and some ware delivered to the placers in saggers. Car unloading, ware carrying, and sagger handling were studied, the ratio of time necessary for these operations against placing was determined, and a value was established.

A formula was constructed in which a unit value for each class was determined, the unit value covering all operations in the group.

None of the workmen had ever been "time studied" before and they were indifferent in their attitude toward it. From the beginning, nothing concerning the system was kept from them. Questions and suggestions were encouraged and if they appeared interested, the time-study man volunteered additional information in order to gain their confidence.

Before the time values were put into effect, the foreman, superintendent, and time-study man together classified the work and established hourly rates for each operation. Previously there never had been any system in setting hourly rates in this department. The rate classification resulted in most men getting a reduction and a few getting increases, but the fairness of it was never questioned.

Eight men were transferred to other work, leaving eighteen men selected by the foreman and time-study man to do the work formerly done by twenty-six men. These eighteen men were called together the day before the time values were put into effect. The entire plan was explained by the superintendent, foreman, and time-study man and questions against the plan were invited.

The plan was a success from the beginning and, with a few exceptions where the day work rates had been abnormal, hourly earnings were increased. The savings to the Company was $8500 per year.

The group system is sometimes criticized because it appears to be unfair to the very fast workman but it has been found that it is possible to classify the jobs so that every man receives an hourly rate which enables him to earn according to his ability. On the other hand, the advantages are many. It allows more flexibility in the distribution of the work, speeds up training of new workmen, promotes coöperation, reduces supervision and payroll work, and enables the grouping of time values into a unit for a good completed piece of ware with no payments being made for ware which is spoiled before the final operation in the group.

V. Conclusion

The reaction of the employees to the plan has been favorable. The time values are a real incentive to increase earnings by increasing production and are not merely a measuring stick to grind the most work out of an employee for the least money.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
DERRY WORKS, DERRY, PENNSYLVANIA

TIME ANALYSIS AND MOTION STUDY*

By Frank Cermak

The following paper is an outline of standard practice in time-study procedure as practiced on repetitive work.

I. Definition

Time study involves a searching, scientific analysis of methods and equipment and the development in minute detail of the most efficient motions and combination of motions required to perform a given task with a minimum amount of effort or fatigue.

Its objects are (1) to reveal inefficiencies or irregularities in the performance of operations, (2) to establish and standardize conditions favorable to efficient operations, (3) to eliminate all unnecessary motions or ineffective efforts, (4) to establish reasonable and consistent standards of performance by which efficiency can be measured, and (5) to furnish reliable data for use in compiling formulas or bases from which future standards can be computed and consistency assured.

II. Equipment

The equipment used is a decimal minute watch, a standard time study board (special design), and Time Study Form S.W. 3474 for recording observations when elemental operations necessary have been standardized in proper sequence.

III. Selecting the Operator to Be Studied

Care should be exercised in the selection of the operator to be studied. He should be thoroughly accustomed to the method of doing the work so that he will proceed without hesitation or delay from one operation to another in a systematic and efficient manner before a final study is taken.

Other advantages being equal, it is more desirable to make the study on the most skilful operator and rate him accordingly when computing the standard.

IV. Approach to Operator

To obtain the confidence and coöperation of the employee it is essential that the use of a stopwatch and the purpose and procedure of time-study work be explained to him in detail. His coöperation should be enlisted in experimenting and trying new methods, motions, and sequence. He should be encouraged to offer suggestions and to try them out. Above all things, he should be impressed with the fairness of the objects and results of such procedure and company policies in general.

V. Preliminary Analysis

(1) Routine of Work Before proceeding with any written data, the rate man should familiarize himself mentally with everything affecting the time required to perform the work. He should analyze the job with respect to the method, conditions, and inspection requirements. He should find out the reason for performing the operation. Such an investigation sometimes shows the operation to be actually unnecessary or that it can be greatly simplified.

Other points which should be noted are as follows:

(*a*) Check up on similar operations as performed elsewhere.
(*b*) Determine whether any improvement can be made in the tools, equipment, or handling methods.
(*c*) Note the condition of the machine and its capacity, feeds, and speeds.
(*d*) Note the size and shape of the tools.
(*e*) Note the supply of the tools or materials and the handling conditions.
(*f*) Note the jigs or fixtures, etc.
(*g*) Consult with the foreman and enlist his coöperation in establishing and maintaining the best conditions possible. See that the best available feeds and speeds are maintained.
(*h*) Proceed to analyze from the viewpoint of motion economy and select the necessary operation and the most efficient sequence.
(*i*) Record the selected operations on Time Study Form S.W. 3474.

(2) Rules In doing this the following rules should be observed as closely as possible:

(*a*) Major operations should be broken down into the smallest elements which can be observed with a minimum possibility of error in recording time. In this connection time values of less than 0.05 minute are difficult to observe unless followed by a longer duration of time.

(*b*) Elements whose time value should be

* Presented at the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February, 1933 (Management Session). Received March 22, 1933.

independent of size of piece (constants) should, as far as practicable, be separated from those which are dependent (variables).

To avoid inaccuracies in reading the watch, it is important that the exact point of motion at which each elemental operation begins and terminates should be well defined and easy to observe without detracting whole attention from the watch and the time-study sheet. If subject to other interpretation, these points should be recorded.

Possibility of error is also greatly reduced if elemental operations are memorized before recording observations.

Enlist the coöperation of the worker to try out other arrangements where advisable.

Before making final observation see that the operator is thoroughly familiar with the new procedure and where radical changes have been adopted it is generally advisable to delay further study, allowing ample time for the operator to form the new habit cycle.

VI. Final Study

(1) Records (*a*) Record date and time of day, start and finish, at the top of the time-study sheet.

(*b*) Enter drawing number, part number, operator's name, etc., in spaces provided.

(*c*) Record in detail all tools, feeds and speeds, and equipment used.

(*d*) Record inspection requirements and handling conditions.

(*e*) Record all other conditions in detail affecting the time value.

(*f*) Comment on condition of the machine tools.

NOTE: Repetitive work and number of machine tools should be recorded.

(2) Observations Take up a position (standing) to the right or left of the operator where all motions can be readily observed.

Position the board and the watch so that the eye has simultaneous vision of watch, board, and work.

Start the watch but do not begin to take observations until assured that the operator has become preoccupied with his task and his natural efficiency is not affected by your presence.

Read the continuous time (do not snap the watch back to zero at the end of each cycle).

After the first observation the minute reading may be omitted and only decimal reading recorded if care is exercised to check the location on the sheet each time the hand passes zero reading on the watch.

Insist on a selected sequence being followed during observation.

Note all the irregularities which occur during the observation, using standard marks or symbols as outlined on the accompanying time-study blank.

Unavoidable delays or foreign operations should be explained in detail at the bottom of the time-study sheet before leaving the job.

Foreign operations which can not be eliminated should be explained in spaces immediately following the last regular element in the sequence in which they occur and a time value computed thus:

$$\frac{\text{Selected time for foreign operations}}{\text{Number of cycles allowed between recurrence}}$$

Unavoidable delays which can not be eliminated are, in most cases, covered by standard allowances and should be so noted on the time-study sheet. Special cases may be treated as foreign operations.

Reason for avoidable delays may be next recorded if considered advisable for later discussion with the operator.

Time involving delays of any kind should not be considered in computing selected time.

Where the time observed for the same elements in different cycles varies to a greater degree than 20%, the observer should attempt to discover the reason for the variation by concentrating on that particular elemental operation, making special checks if necessary. Where a wide variation occurs such analysis frequently leads to a discovery of an undesirable condition which can be corrected or improved.

If shown to be beyond the control of the operator and conditions can not be remedied, explain at the bottom or on the back of the time study. Where such variations, however, are of frequent occurrence throughout the study and are shown to be caused by the inefficiency of the operator, such inefficiencies and their remedy should be pointed out and the job restudied when further training has corrected the condition.

Where the same element occurs more than once in a given cycle under exactly the same conditions, readings in all cases should be combined in computing the selected time.

Following an observation see that the work observed is checked by the inspector and note the degree of precision maintained during the study.

(3) Method of Selecting Time Selected time is computed as the square root of the product of the average time taken for each element and the minimum.

The total selected time for the complete cycle equals the summation of selected elemental time plus the time allowed for foreign operations as above outlined, multiplied by the grade rating of the operator observed.

Allowed time is computed from the selected time by adding standard allowances for personal fatigue, machine tool maintenance, and working tool maintenance.

If the workmen being studied are regular piece workers, they should be assured of the average earning rate during the period of study.

(4) Rating the Operator In rating the operator as to speed of performance, care should be exercised to insure the highest degree of consistency and fairness possible. Ratings of various operators on different classes of work may be compared to advantage.

A good average operator is rated as 1.00. An operator as 1.10 would indicate he is 10% faster than a good average and one rated as 0.90 would indicate he is 10% slower than the average, etc. Grade rating should be recorded in the space provided on the back.

All studies should be carefully rechecked for errors in computation, etc., before setting the standard.

General Electric Company
Schenectady, New York

ACTIVITIES OF THE SOCIETY

Officers of the Industrial Divisions

L. E. Barringer, E. deF. Curtis	Art	H. F. Kleinfeldt, V. V. Kelsey	Materials and Equipment	J. O. Everhart, W. C. Rueckel	Structural Clay Products
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H. H. Blau, S. R. Scholes	Glass			Louis Navias, R. F. Geller	White Wares

A PROGRESS REPORT ON RESEARCH IN TABLEWARE DESIGN*

By Arthur E. Baggs

This report covers a period of eight months' work, from February, 1932, to July 1, 1932, and from October 1, 1932, to February, 1933. Funds granted for this study were originally intended to finance only two years of work, ending July 1, 1932. Hope was expressed by the donors that provision might be made by the tableware industry to continue the work after this introductory period. Because of general business conditions in 1932 the prospect of securing additional support seemed so doubtful that those in charge of the study decided to conserve the funds and spread the development work over an additional year with the hope that improved business conditions might then make industrial backing possible. Upon petition to the General Education Board, permission was granted so to extend the period of study, although no additional money was appropriated. Funds now in hand will carry on the work until July 1, 1933, after which time the project can be continued only through renewed financial support from industrial or other sources.

Since the date of the last report made before the Art Division of the American Ceramic Society in February, 1932, design studies have been carried out along three general lines.

I. Embossed Patterns

Through the coöperation of several dinnerware manufacturers, a series of embossed plates was produced under plant conditions. Shells for standard eight-inch plates of four types were obtained from the Sebring Pottery Co., Crooksville China Co., Edwin M. Knowles Co., and Homer Laughlin China Co. Embossed patterns were executed on these shells which were then returned to the plants where molds were made from them and ware was formed and fired.

The patterns were largely variations of existing types, illustrating the possibilities of varying the proportions of pattern elements in relation to the proportions of the plates themselves. Many of the patterns were designed with the idea of leaving suitable areas for application of various color decorations in overglaze and underglaze, which should be definitely related to the embossed pattern and present a unity which is often lacking when unrelated sprays are applied on embossed ware. Several samples of each of these plates, both glazed and unglazed, were executed at the plants and returned to the University for experimental decoration in color.

II. Decalcomania Studies

About four months' work was given to the study of patterns for reproduction in decalcomania. Color sketches were made and submitted to several dinnerware manufacturers for comment and criticism.[1] The designs cover types in common use, including border sprays, free sprays, center sprays, medallions, geometric borders, landscape centers, and varying combinations of these designs.

An interesting project which was carried out during this period was the design competition for tableware decoration which was sponsored by the W. S. George Pottery Company of East Palestine, Ohio. This company offered to students of the Fine Arts Department at Ohio State University a series of prizes amounting to $100 for suitable decorations to be executed in decalcomania on one of the standard shapes produced by their plant. General supervision and help with this project was undertaken as a legitimate part of the work of the decalcomania study then being carried on. No designs by Mr. Bogatay were included in the competition, but he gave his advice and criticism to that of the design department in helping the students to plan usable decorations. The competition aroused much interest among the students and produced a number of creditable patterns.

During the summer, from July 1 to the opening of the college year, October 1, work was discontinued. In October, 1932, the problem of designs for transfer printing was resumed. Black and white sketches were made covering many types of borders and center decorations for round plates. These were intended to be suitable for hotel or household ware.

At the suggestion of Mr. Purdy of the American Ceramic Society, several special patterns were produced for the specific purpose of suggesting appropriate and attractive decoration for souvenir plates commemorating the Century of Progress Exposition in Chicago. These black and white sketches were submitted to ten manufacturers in the Pittsburgh and Sebring districts. Of the designs shown, twenty were retained by those interested for proofing as possibilities for commercial use.

* Research in Tableware Design at the Ohio State University, sponsored by the General Education Board under the Rockefeller Foundation.

Presented at the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February, 1933 (Art Division).

[1] An exhibit of these sketches was shown at the spring meeting of the White Wares Section of the Ohio Ceramic Industries Association, held at East Liverpool in May, 1933.

Three plants made requests for special service on individual problems and an attempt was made to satisfy their wishes with partial success.

Because of the constructive interest shown by the manufacturers in these designs and others which had previously been shown to them, it has been decided to make all of the designs produced in the study available for commercial use by any producers who are sufficiently interested to avail themselves of the opportunity. Special patterns at a reasonable charge may also be developed for manufacturers wishing such service. Any receipts resulting from such activities will revert to the general expense fund and will be used for further development work.

III. Plans for Future Development

Since January 1, 1933, the projects under way have to do with decorative process work. Decorations are being applied to some of the embossed plates which were developed earlier in the study. Designs are being worked out directly on the plates using various methods. Some have been produced by ground-laying a color tint and cutting away the pattern in the manner of *sgraffito*. This technique produces interesting effects which would be easily adapted to transfer printing through reproduction by the Kerr process or other printing processes.

Other methods which will be used are silk screen stencil transfer printing, stencil and air brush, rubber and sponge stamps, and direct painting. These methods will be tried in both underglaze and overglaze.

IV. Shape Construction

It is now planned to devote the last months of the study under its present backing to a more advanced consideration of shape construction, in which interesting preliminary work was done during the first year. Three types of round shapes will be studied: the plain type, the fluted type, and the embossed type. The fluted type will be based on study of early shapes, the others on principles of design and fundamental form. The items to be considered will be eight-inch plates, tea, cream and sugar, and an eight-inch casserole. Color decoration will be developed for each type in a style suited to the shape and with careful consideration of the limitations of commercial reproduction.

V. Future Continuation of the Research in Tableware Design

Under its present sponsorship, the tableware design research will end in June, 1933.

Much hard sincere work has been done by the holder of the Fellowship. Interesting, progressive, and fundamentally useful results have been developed. In a way, only the surface has been scratched in this undertaking. With the momentum of increasing knowledge and skill, such a study should in time produce work of widely recognized value to the industry and to the designer or teacher of designs.

This research was the first of its kind to be tried in this country. It is experimental. Mistakes have inevitably been made in some of its steps of development, but its purpose has been sincere and it has made progress. It is unfortunate that its period of operation coincided with a time of forced conservation and conservatism in the industry. This has limited the enthusiasm and financial support with which such a project might be received in more expansive times. Even now it does not seem impossible that some way may be found to provide for the continuation of this excellent work by a young man who has demonstrated his talent and ability to grow in knowledge of the tableware designer's problems.

There is an endless amount of useful development work to be done, not only in more intensive study of the various branches which have so far been touched upon but in other allied lines of investigation.

Some activities which have been suggested for future work are these:

(1) The compiling of a history of the dinner plate for publication, showing outstanding examples of shape, decoration, and color treatment from earliest times to the present with an analytical study of the principles of design involved and notes on the cultural background which produced the various styles.

(2) Certain studies which perhaps occupy a borderland between art and engineering, such as a study of cross-sections of plates with compilation of data on strength, warpage in drying and firing, comparative weight, and beauty of line and form.

Another similar study might attempt to secure fundamental data on the designing of spouts that pour more efficiently and of handles that offer most convenience to the user.

(3) Development of little-used decorative processes, ways of making transfer prints other than lithography and engraving, and development of new tints in the colored body pallette. These and other semitechnical studies would seem to have a place in tableware design research.

(4) Market studies. A research field in itself and probably not wisely to be undertaken except in collaboration with trained commercial investigators.

It is to be hoped that the beginning which has been made in establishing a continuous specific study of tableware design problems will not be allowed to lapse just as it is acquiring enough momentum to become more and more effective.

Despite the rather doubtful immediate future and the depressing recent past, progressive development in the tableware industry will continue. Growth in the right direction will depend on active influences consistently maintained. An organized continuous research in design can not fail to exert increasing benefit as it progresses.

Acknowledgments The industry, as represented by many individual plants, has been generous in its coöperation and help in furnishing materials and carrying out projects under plant conditions. Individuals, notably F. H. Rhead of the Homer Laughlin China Co., Newell, W. Va., have helped greatly with sound advice and constructive criticism. The thanks of all who are connected with the work are hereby extended to these plants and men.

ENAMEL DIVISION BY-LAWS AMENDMENT

The following amendment to the By-Laws of the Enamel Division has been passed by a mail ballot of 34 to 1:

Be it resolved that the By-Laws of the Enamel Division

be amended by adding to Section VII (Standing Committees) a second paragraph as follows:

"Three members of the Enamel Division shall act as an Editorial Committee. The Division Chairman shall appoint three members to act as the first Editorial Committee. One of these shall be designated to act for one year, one designated to act for two years, and the third to act for three years. Succeeding Division Chairmen shall each year appoint one member of the Division to serve on this Committee for three years. The Chairman of the Committee each year shall be the member retiring at the end of that year. The retiring member may be reappointed if the Chairman of the Division so desires."

AMERICAN CERAMIC SOCIETY ADDITIONAL COMMITTEE APPOINTMENTS[1]

(1) American Ceramic Society, *Refractories Division, Membership Committee, Chairman:* Hobart M. Kraner, Corhart Refractories Co., Louisville, Ky.

(2) National Bureau of Casualty and Surety Writers, *Sectional Committee on Specifications and Methods of Testing Safety Glass:* J. T. Littleton, Corning Glass Works, Corning, N. Y.; *alternate:* Donald E. Sharp, Bailey and Sharp Co., Inc., Hamburg, N. Y.

(3) American Association for the Advancement of Science: Gordon E. Fulcher, Century of Progress, Chicago, Ill.

(4) American Society for Testing Materials:

(*a*) *Committee A-1* (steel): Robert D. Landrum, Harshaw Chemical Co., Chicago, Ill.

(*b*) *Committee C-3* (brick): A. F. Greaves-Walker, North Carolina State College, Raleigh, N. C.

(*c*) *Committee C-8* (refractories): E. H. Van Schoick, Chicago Retort & Fire Brick Co., Ottawa, Ill.

(*d*) *Committee C-10* (structural tile): Ross C. Purdy, American Ceramic Society, Columbus, Ohio

(*e*) *Committee D-9* (electric insulation): L. E. Barringer, General Electric Co., Schenectady, N. Y.

[1] For the Official Personnel of Officers and Committee Appointments for 1933–1934 see *Bull. Amer. Ceram. Soc.*, **12** [6], 202–204 (1933).

NEW MEMBERS RECEIVED IN APRIL, MAY, AND JUNE

PERSONAL

Chester R. Austin, Ohio State University Engineering Experiment Station, Roseville, Ohio.

William L. Beck, Drawer 285, Macomb, Ill.; Sales Manager, Buckeye Pottery Co.

George H. Diack, North American Refractories Co., Lock Haven, Pa.

Grover Cleveland Foresman, 142 Pine St., Corning, N. Y.; Supervisor of batch mixing, color control, and melting, Corning Glass Works.

Otto A. L. Krause, Adolf-Hitler Strasse 37, Breslau 1, Germany.

Laurence Meharg, Fifteenth and Jacob Sts., Wheeling, W. Va.; Chief Engineer, Hazel-Atlas Glass Co.

Alfred Vaksdal, 164 E. Pulteney St., Corning, N. Y.; Plant Engineer, Corning Glass Works.

STUDENT

Byron B. Josi, University of Illinois, Urbana, Ill.

Membership Workers' Record

PERSONAL		STUDENT	
F. C. Flint	1	A. I. Andrews	1
J. C. Hostetter	2		
E. M. Weinfurtner	1	Grand Total	8
Office	3		
Total	7		

Membership Renewals

CORPORATION

Universal Clay Products Co., Sandusky, Ohio.

PERSONAL

H. F. Eilers, 162 Watauga Ave., Corning, N. Y.; Corning Glass Works.

"WIN WITH WISDOM"

A Message from the Membership Committee

Civilization requires that men coöperate. Men act wisely only when they most fully coöperate. Mutual dependence dictates mutual assistance and fellowship. This is the basic reason for and the motive of organized collaboration in social, civic, educational, trade, and scientific affairs. Civilization and all that it portends depends on the extent to which men organize for their mutual welfare.

The American Ceramic Society came into being because progress in industrial ceramics was dependent on ceramists pooling their efforts to find, record, and apply scientific and technical information. The business welfare of industries is enhanced in ratio with the unanimity of support given by producers to trade association activities. The technical welfare of the ceramic industries is enhanced according to the unanimity of collaboration of producers in their technical society, The American Ceramic Society.

The main reason for wanting a one hundred per cent support for The American Ceramic Society activities is to obtain the maximum coöperation in finding, recording, and applying information to ceramic arts and technology.

Wisdom is knowledge applied. Wisdom is "ability to judge soundly and deal sagaciously with facts." Wisdom is "knowledge with capacity to make use of it." Wisdom is "perception of the best ends and the best means."

The optimum of wisdom in ceramics will be developed when the American Ceramic Society shall have the maximum of unanimity in support by ceramic persons and manufacturing concerns.

"WIN WITH WISDOM" in these days of economic recovery. Nonceramic product competition is rapidly increasing. Higher quality and lower costs are required.

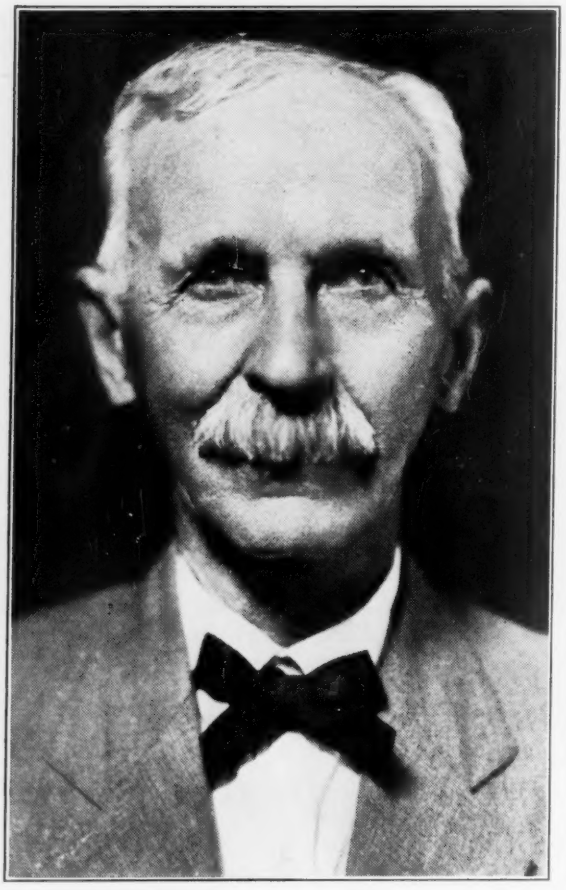
Personal membership fee is $10.00, Corporation membership $25.00.

NECROLOGY

James B. Wilcox

"Uncle Jim," as he was affectionately called by his fellow members of the European ceramic tour, has passed away. He is the first of that happy party of eighty persons to die.

Mr. Wilcox, aged seventy-seven, died Thursday, June 22, after several weeks of illness. He enjoyed living and many friends (about one thousand) viewed his remains and left flowers as a tribute of sympathy and love. There were many friends who enjoyed living with "Uncle Jim."



JAMES B. WILCOX

His business associates, his employees, his neighbors, and his competitors deeply mourn his passing.

J. B. Wilcox was born in Deerfield, Ohio, March 20, 1856. Successively as a farmer boy, a stone mason, a brick mason, a designer, a builder and contractor of open-hearth steel furnaces, a general contractor, manager and president of the Alliance Clay Products Company, and stockholder and director in other business organizations, Mr. Wilcox gave evidence of his superior engineering and business talents. The three plants of the Alliance Clay Products Company, with a combined capacity of 270,000 brick per day, are unique in layout and for the many devices which Mr. Wilcox designed.

Broad-mindedness, generosity, modesty, and eagerness, were marked characteristics of "Uncle Jim's" sterling character. He welcomed visitors at his plant and at his home. With pride and simple pleasure he showed and permitted others to use the devices which he invented and used with success.

The seventy-seven year old "boy" Jim romped through Europe and England with the ceramic "troupers," always eager and ready to go. He was one of the four "youngsters" who walked down from the top of a snow-capped Alpine mountain to a lake wharf where a boat awaited to take the party back to Lucerne. Without rest, he attended the evening event and was up early the next morning ready for the program of events of the next day. Jolly, thoughtful, tolerant, and yet reserved in his actions and speech, "Uncle Jim" was the most beloved person of that ceramic party.

It is not difficult for those who became his intimates on that six weeks' tour to understand why he was loved and respected by all with whom he came into contact during his seventy-seven years on earth.

By virtue of the greatness of his heart and mind and by dint of hard, faithful, and studious work J. B. Wilcox was successful. He acquired wealth in material and spiritual things. He invented, built, and successfully operated devices by which useful products of a better kind and at less cost were produced. Mrs. Wilcox preceded her husband in death by eight years. Since that time his daughter, Mrs. Eva Miller, together with her family, lived with Mr. Wilcox. He is also survived by another daughter who, with her family, resides in Canton, two sons, J. Oatis Wilcox and Daniel Wilcox, and seven grandchildren. His family life was happy and richly blessed.

"Uncle Jim" maintained for himself a personal membership and for his firm a corporation membership in the American Ceramic Society because he possessed an understanding faith in the ideals and principles which form the basis of technical ceramic progress.

The members of the Society deeply regret that they have lost the inspiration and comradeship of a faithful friend who was constantly devising ways and means by which the art of brickmaking has been advanced.

ROSTER CHANGES FOR APRIL, MAY, AND JUNE*

PERSONAL

Barger, H. D., 435 Vermont Place, Columbus, Ohio. (Wellsville Fire Brick Co., 1611 E. Erie Ave., Lorain, Ohio.)

Bennett, A. Lee, 661 W. Burchett St., Glendale, Calif. (1130 N. Providencia St., Burbank, Calif.)

Beverley, Reginald A., 722 Wisner Ave., Park Ridge, Ill. (2626 W. Washington Blvd., Chicago, Ill.)

Callinan, J. Gavin, 484 St. Clair Ave., Columbus, Ohio. (Sheet Glass, Ltd., Queensborough, Kent, England.)

Cook, W. H., 2518 E. 53rd St., Huntington Park, Calif. (131 E. 6th St., Burbank, Calif.)

Crandall, James R., Central Research Laboratories, American Smelting & Refining Co., Maurer, N. J. (2401 Pioneer Ave., Pittsburgh, Pa.)

Crow, Waller, 1812 Tower Petroleum Bldg., Dallas, Texas. (Box 684, New Braunfels, Texas.)

Daniel, George R., 1540 S. 5th St., Ironton, Ohio. (Mellon Institute, Pittsburgh, Pa.)

Dingledine, H. F., National Sewer Pipe Co., Ltd., Wentworth St. North, Hamilton, Ont., Canada. (Aldershot, Toronto, Ont., Canada.)

Dixon, H. G., H. L. Dixon Co., P. O. Box 251, Carnegie, Pa. (P. O. Box 140, Pittsburgh, Pa.)

Ellis-Anwyl, Robert H., Camark Pottery, Camden, Ark. (379–13th Ave., Columbus, Ohio.)

Fogelberg, Sven, R. Johnston & Co., Norfolk St., 40–43, Strand, London, England. (Kosta Glaswerk, Kosta, Sweden.)

Gosser, George W., 438 S. 4th St., Coshocton, Ohio. (Sistersville, W. Va.)

Greaves-Walker, A. McKinley, Research Department, Libbey-Owens-Ford Glass Co., Toledo, Ohio. (Charleston, W. Va.)

Greene, Charles F., 740 Dill Ave. S. W., Atlanta, Ga. (A C Spark Plug Co., Flint, Mich.)

Grossman, Harold, 6 Marshall St., W. Caldwell, N. J. (97 Huntington Terrace, Newark, N. J.)

Hart, Karl, Ogilby, Calif. (7022 Stafford St., Huntington Park, Calif.)

Hellmers, Henry T., Akro Agate Co., P. O. Box 512, Clarksburg, W. Va. (909 Beatty Ave., Cambridge, Ohio.)

Jones, Richard E., 408 Nye St., Lima, Ohio. (470 E. 7th Ave., Tarentum, Pa.)

Keeler, R. B., 8175 Victoria Ave., South Gate, Calif. (R. R. 1, Pacific Palisades, Calif.)

Kerr, W. R., Armstrong Cork Co., Central Technical Laboratory, Lancaster, Pa. (2718 College Ave., Beaver Falls, Pa.)

Kriegel, Wurth, 718 North 64th St., Seattle, Wash. (Gladding, McBean & Co., Renton, Wash.)

Lee, Robert E., 1003 St. Mary's Blvd., Jefferson City, Mo. (Box 753, Rolla, Mo.)

Margetts, Gordon, Fallbrook, Calif. (Box 585, Placer County, Lincoln, Calif.)

Matthes, Archer L., 407 Porter St., N. E., Warren, Ohio. (685 West 4th St., Mansfield, Ohio.)

McCollom, Perry C., 311 E. College, Athens, Texas. (920 Market St., St. Louis, Mo.)

Meeker, R. C., Kentucky-Tennessee Clay Co., 2419 Ridgewood Ave., Alliance, Ohio. (Paris, Tenn.)

Meents, Elmer, 478 S. Wildwood Ave., Kankakee, Ill. (137 N. Perry, Dayton, Ohio.)

Petrie, Earl C., Alexandria, Ohio. (925 Clarissa St., Pittsburgh, Pa.)

Presswood, Colin, "Rockfield," 23 Brocco Bank, Sheffield, England. (74 Harcourt Road, Sheffield 10, England.)

Rees, Robert J., Fall Brook Division, Corning Glass Works, Corning, N. Y. (1181 Broad St., Central Falls, R. I.)

Rexford, Elliot P., 840 Main St., Greenwood, Mass. (Bureau of Standards, Columbus, Ohio.)

Rudd, Richard D., General Delivery, Prescott, Ariz. (905 N. Fifth St., Phoenix, Ariz.)

Schmunk, Louis, Compagnie Nationale des Radiateurs, Dole, France. (Deutsche Standard Werke G.m.b.H., Neuss, Germany.)

Shartsis, Leo, Bureau of Standards, Crestmore, Calif. (1412 Chapin St. N. W., Washington, D. C.)

Shaw, J. B., J. B. Shaw & Sons, 236–42 Liberty St., Harrisburg, Pa. (210 E. Nittany Ave., State College, Pa.)

Shaw, Myril C., 236–42 Liberty St., Harrisburg, Pa. (23 Berkley Place, Columbus, Ohio.)

Sievert, Guilio E., 8169 San Antonio, South Gate, Calif. (199 State St., San Mateo, Calif.)

Spencer-Strong, Geo. H., 227 15th Ave., Columbus, Ohio. (403 E. Washington St., Sandusky, Ohio.)

Spiker, John E., Spiker Tile & Pottery Co., 187 Q St., Salt Lake City, Utah. (1120 Second Ave., Salt Lake City, Utah.)

Spires, Stephen T., Lavino Refractories Co., Womelsdorf, Pa. (103 Jacoby St., Norristown, Pa.)

Stone, Charles H., Jr., 31406 W. Lalo Road, Bay Village, Ohio. (15609 Terrace Road, Euclid, Ohio.)

Strong, Kenneth B., 618 North 62nd St., Wauwatosa, Wis. (7952 Phillips Ave., Chicago, Ill.)

Vickers, A. E. J., Hazeldene, Junction Road, Norton-on-Tees, County Durham, England. (Wolstanton, Stoke-on-Trent, England.)

Walker, Thomas, La Luz, N. M. (La Luz Clay Co., Alamogordo, N. M.)

Zimmer, David C., Box 146, Newcomerstown, Ohio. (1554 Teakwood Ave., Cincinnati, Ohio.)

* The address within parentheses represents the old address.

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NOTES AND NEWS

SILICOSIS

Racketeer lawyers and doctors have added to industrial hazards the liability of unwarranted financial losses, as though it were not bad enough to have the possibility of workmen contracting silicosis in spite of every possible warning and precaution.

Silicosis and all other lung troubles classified under the more general term "pneumoconiosis" have, no doubt, always afflicted those who were at all active in factories, in streets, or on farms. Science and science methods have disclosed these lung troubles. An accumulation of data and case histories has made more evident the causes and results. With increasing facilities and the acquisition of authentic scientifically exact observations there has been on the part of plant managers a growing sense of responsibility and the need for protective devices for their employees. As a reward for these humanitarian disclosures and efforts, the racketeering lawyers and doctors have seen the chance for making easy money.

It behooves every ceramic manufacturer to prepare a defense against silicosis damage suits. The plant must be as free from fine air floating dust as is possible and the men must be warned and provided with dust masks. But these precautions are not sufficient. The plant managers must be prepared to show medical and X-ray records.

As further evidence[1] of the seriousness with which the scientists have studied the matter of silicosis the following one hundred and thirty-five references are given from a report by H. K. Pancoast and E. P. Pendergrass.[2] Concerning these references the authors make the following statement:

The references we have been obliged to consult were very numerous. The literature during the past few years has been replete with articles dealing with the various phases of dust inhalation. We are obliged to restrict our list of references to those articles which present particular points of interest to the roentgenologist. We have been obliged to omit many of the references included in our previous presentations.

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[1] See Editorial on "The Silicosis Racket," *Bull. Amer. Ceram. Soc.*, **12** [5], 127–34 (1933).

[2] *Amer. Jour. Roentgenology and Radium Therapy*, Vol. XXVI, No. 4, October (1931).

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CERAMIC SCHOOL NOTES

NEW YORK STATE COLLEGE OF CERAMICS AT ALFRED UNIVERSITY

Dedication Exercises for the New Ceramic Building, at Alfred, New York, June 12, 1933

Introductory Remarks by Dean Major E. Holmes

I should like to call attention to the background of these dedication ceremonies which our friends have made possible for us to arrange for today.

The New York State College of Ceramics, recently elevated to that status from the status of a school, is the only institution in New York devoted to higher education in ceramics. For the current year its enrollment is 247, this figure representing a 40% increase over that of the preceding year. There is a staff of twelve instructors, each a specialist in his line of work. The College is organized on the basis of three departments, that of General Technology and Engineering, Glass Technology, and Ceramic Art. The courses of study embrace all fields of the ceramic industries in their three essential aspects of technology, engineering, and art. The school now consists of three buildings including the new one to be dedicated today, and affords 40,000 square feet of floor space devoted to lecture rooms and laboratories. New, up-to-date equipment worth $40,000 has been installed in this new building during the past year and $15,000 worth will be installed in the coming year.

This large expansion program of the past year has more

than doubled the size of the school and the equipment and has materially relieved the serious restrictions that have prevailed in the past. That such restrictions were severe is indicated by the large increase in enrollment the past year. It might be worth while, however, to note that we are again confronted with the necessity of restricting enrollment.

My purpose in mentioning these facts is to bring out the contrast of the present status of the institution with the conditions that prevailed thirty-three years ago when the Alfred pioneers established this school of ceramics. In that year $20,000 was provided to construct the building, equip it, provide for maintenance, and pay salaries. The student body was negligible. Although Ohio State University had started the movement a short time before, ceramic education was as yet an unknown quantity, much less being established, and even the ceramic industries doubted the need of it. It took vision to see the widespread and essential place that ceramic education was destined to hold in the educational system of the entire country, and particularly its possibilities at Alfred. It took courage to launch the venture and it took genius to build it up to the present status which I have just described. With Ohio State University, this institution has blazed the trail of ceramic education and at Alfred University it has culminated in the present status of the New York State College of Ceramics.

The most interesting side light of this background of today's ceremonies is that this entire third of a century of growth and development at this institution has been under the continuous executive direction of one president and under the administration of one director. This record is unique in the annals of ceramic education and it may be observed that in the recent establishment of the glass technology department, the first in America, we have evidence of that same courage and vision that gave birth to the institution thirty-three years ago. It is most fitting that the dedication of the new building should come at just the time that our distinguished president must lay down his duties as executive head of this institution, and so soon after the similar retirement of my honored predecessor, the director emeritus. The building may well serve as a monument to their great careers. As the building may serve as such a monument, so may the busts of the president and director which we have recently placed in the assembly room of the new ceramic building serve as symbols of the admiration and love for them by us who are to carry on, and they shall be a constant source of inspiration to us in the years to come. The making of these busts was not a commercial undertaking, but they were modeled by one of us, Miss Elsie Binns, and they are not made of bronze but of basic ceramic material, enduring clay.

The aims and policies of the New York State College of Ceramics shall be those of the past modified only to the extent that new conditions demand and enlarged appropriations permit.

These policies include the development of effective contact with the industry, emphasis on basic scientific work and the heavy applied engineering work, and the direction of the art work to the industrial problems. The policies include also a desire to grow better rather than larger.

FELICITATIONS FROM THE AMERICAN CERAMIC SOCIETY TO THE NEW YORK STATE COLLEGE OF CERAMICS

By John Clyde Hostetter

President Davis, Governor Lehman, Dean Holmes, Distinguished Guests, and Friends of the New York State College of Ceramics:

It is indeed a rare privilege and a duty most pleasant to participate in a humble capacity in these impressive ceremonies that are of such great portent to the ceramic industries of America.

Primarily, we are assembled here today to dedicate, with appropriate form and ritual, a magnificent building, generously provided by the people of New York State, to the service of ceramic education. But this occasion is much more than the mere ceremony of dedicating a mass of brick and mortar. This new building, with its excellent modern laboratories and scientific equipment, symbolizes the transition from ceramics as an empirical art to ceramics as a science, a transition that has been taking place with ever-increasing rapidity since this college was founded. Craftsmanship is being supplemented by technical knowledge; the potter is aligned with the scientist in the advancement of ceramic art.

This occasion will also go down in ceramic history as of paramount importance to the glass industry of the country, for today we are dedicating a school of glass technology, the first educational unit of its kind in the country. And even more, for today signifies the culmination of many years of devoted service and inspired leadership of your retiring president who has seen, as a fond father watches his growing child, the growth and development, during a third of a century, of this fine college of ceramics. It is indeed quite fitting that the members of the American Ceramic Society, devoted to the arts and sciences of the silicate industries, should recognize this momentous occasion and extend, through me, as president, their sincere felicitations.

The growth of the New York State College of Ceramics has not been left to chance; it has been guided by a great leader. It was the wise leadership of President Davis that builded this college. Dr. Davis claims no intimate knowledge of ceramic technology, but he does know men. His choice of Professor Binns, as the first director, assured in itself the success of this school of ceramics.

Dr. Davis, you have accomplished much for ceramics. The ceramists of the country wish formally to recognize these accomplishments and so, Sir, it is my pleasure to present to you this illumined scroll, embellished with the seals of New York State, Alfred University, and the American Ceramic Society inscribed as follows:

The Board of Trustees of the American Ceramic Society, with greetings to the Trustees, Faculty, Alumni, and undergraduates of the New York State College of Ceramics, wish hereby to testify that Boothe Colwell Davis, as President, New York State School of Clayworking and Ceramics, 1900–1932, and President, New York State

College of Ceramics, 1932–1933, by rare executive planning, foresight, and diligence did establish and develop at Alfred, New York, a ceramic educational and research institution which has done much and which will continue to enhance academic and industrial ceramic welfare.

Appreciation of services rendered is attested by seal and official signatures of the AMERICAN CERAMIC SOCIETY.

Presented June the twelfth Nineteen hundred and thirty-three.

J. C. HOSTETTER, *President*
ROSS C. PURDY, *General Secretary*

And now to President Titsworth, to you, Dean Holmes, and to your faculty, we extend our wishes for continued success in carrying on the work of the New York State College of Ceramics. We know that under your administration and guidance there will result even greater accomplishments in advancing ceramic education and research and hence the ceramic industries of America.

PRESENTATION OF ALBERT VICTOR BLEININGER FOR THE HONORARY DEGREE OF DOCTOR OF SCIENCE

BY S. R. SCHOLES

MR. PRESIDENT: I take pleasure in presenting for an honorary degree a man who is beloved for the sweetness and generosity of his character, as well as admired for the extent of his scientific achievements.

He has had a typically American career: an immigrant boy, becoming a clayworker, then in turn a graduate of Ohio State University, a teacher there, associated with Professor Edward Orton, a government scientist, a university professor, and now chief ceramist of one of the great china factories.

For more than thirty years a leader in the American Ceramic Society, he has served it in many capacities: on committees, as editor, and as president. He was among the first to be chosen a Fellow of the Society. He is one of that small number of men whose loyalty and devotion have built and maintained the American Ceramic Society.

When the World War found us in dire need of optical glass, it was he who devised a means for casting clay melting pots, thus accelerating the production of that vital necessity.

When I first met him, more than twenty years ago, it was to ask his advice on a ceramic problem. His help was freely given, as it has been to many others. He remains the friend and counsellor of all who work with silicates. He edited a translation of the writings of Herman Seger, so that a great textbook became available. He is the author of a work on cements and the writer of many published papers on silicate technology. His scholarly address of today displays his skill in exposition.

Since "Doctor" means "teacher," it is most fitting that he should be so called.

Mr. President, I am sure that Alfred University will honor itself by conferring a degree upon this gentleman and scholar. I therefore present for the Honorary Degree of Doctor of Science, Albert Victor Bleininger.

NORTH CAROLINA CERAMIC ENGINEERING STUDENTS AGAIN WIN CUP

Repeating for the third time in the past five years, the Department of Ceramic Engineering at the State College of the University of North Carolina won the *Raleigh Times* cup for the best departmental exhibit at the recent 1933 Engineers' Fair. Two sophomores, W. R. McLain and R. B. Worth, also were awarded the second prize for the best individual exhibit, consisting of fifty pieces of art pottery.

The award of the cup was especially pleasing to the ceramic students because the governor of the State, J. C. B. Ehringhaus, and the president of the University were among the judges.

As usual the exhibit that attracted the greatest amount of comment and attention from more than 4000 visitors was the display of artware produced by the students out of class hours. Making the pottery display for the annual Fair has become the major project of this Student Branch of the American Ceramic Society and each year a decided improvement is shown in the quality of the work.

In addition to the pottery exhibit there was also shown a display of ceramic products, including glass, refractories, structural products, floor and wall tile, electrical porcelain, etc.

In the laboratories the students demonstrated the manufacture of dry-pressed and cast whiteware from the preparation of the raw material to the firing of the product, various groups operating, grinding, blunging, pressing, spraying, and other equipment. Sheet-steel enameling was also demonstrated from pickling to firing.

In the Engineers' Parade the Keramos Chapter had a large float, the center piece of which was the fraternity's honor key.

George J. Grimes, a senior in the department and president of the Engineers' Council, was in charge of the Engineers' Celebration this year and John H. Isenhour, another senior, was in charge of the Engineers' "Grand Brawl." Grimes was also president of the Student Branch, and Isenhour president of the Keramos Chapter.

The souvenirs distributed to visitors this year were "bambino" plaques in blue and white, made by the freshmen in the department under the supervision of George A. Wills, Ohio State University, '27, who is working for his Master's Degree.

CERAMIC SHOW AT IOWA STATE COLLEGE

Earl Solomon, president-elect of the Student Branch of the American Ceramic Society of Iowa State College, was named by his fellow students as director of the Open House Show of the annual Veishea, May 12.

Solomon chose to make his show a combination of the "Buy American" idea and the Diamond Jubilee celebration of Iowa State College. Since Iowa State College was founded seventy-five years ago, the show was built around a collection of stoneware made just seventy-five years ago in Boone, Iowa, by a pioneer potter.

Added to this pottery collection were drain tile, dug up from Iowa farms, which had been made on the potter's

wheel in other parts of the State in the early settlement. A section of pipe used in a stoneware pump, also kicked out on the wheel, and a drain tile made on a brickmaking device were in the collection. Arthur White, of Fort Dodge, Iowa, for many years a manufacturer of common stoneware, sent a collection of the first Bristol glazed stoneware made in Iowa.

The remainder of the show was made up of ware produced in Iowa showing the progress in quality during the seventy-five years of the life of the College.

The best feature of the show, however, was the display of fine American made earthenware from the stock of Des Moines merchants. The Veishea show has never had to apologize for American hotel ware or Lenox chinaware, but American earthenware has sometimes appeared shabby when displayed close to the English lines. The "Buy American" movement seems to have been justified. Since Veishea is held for the community, rather than for the students, and the visitors represent the buying public, the presence of this display made a most wide-spread and effective appeal.

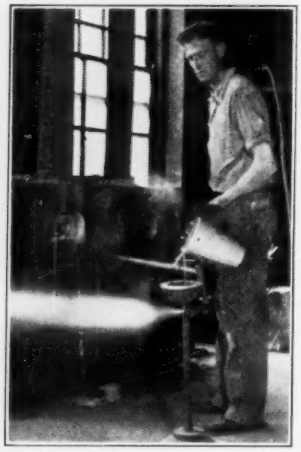


FIG. 1.—Making frit wool.

A good collection of old American glass was loaned by a local antique dealer.

In the avocational pottery display, demonstrations were given by students in decalcomania making, copper plate printing, work with lithograph stones and etching of plates, and printing on ware by transfer from papers, together with lining and gilding the ware. This work is required from students in the four-year course in Ornamented Ceramics.

FIG. 2.—This fellow smoked a clay pipe.

A modeler made clay cartoons of the Republican elephant in the posture of Rodin's "Thinker" entitled "Four Years to Think It Over." Another piece showing the elephant striding rapidly away with his fore feet behind his back and erect on his hind legs, was titled "No Place to Go but on My Way."

The students in the laboratories showed the processes of making molds, casting and finishing of ware, brick and tile forming, and enameling of cast-iron paper weights by dry process in outline shape of the State.

The various kilns and furnaces were in operation, each with products that were made from State clays.

A demonstration test of air-quenched enamels was given and the visitors were delighted by the molten glass poured into a current of high-pressure air and then carried in flakes like snow against a screen where it could be collected. This pure white cotton-like enamel frit was given to the visitors, who learned with surprise that this cotton might become a bath-tub coating or could be used as the coating of the castings being handled in the next room.

The potter's wheel as always attracted much interest.

During the year the facilities of the Department were loaned to James King of Mason City, Iowa, who was interested in the development of a tobacco pipe which would be competitive with a cob pipe and be open in structure. The claim by those who have smoked the pipe is that it does not have to be broken in, that it never gets foul, that it never collects a soggy heel, and that it smokes "cool." The staff suggested the method for making the proper mixture to do this work and a student was employed to develop the ideas and make the tests. Since this work brought the desired results just before Veishea, a display was shown of a modeled head of "Popeye," who smoked real tobacco all the evening and made comments in the language peculiar to Popeye. A laboratory air pump helped with the smoking and a student with a funnel and a length of garden hose did the "blow me down."

Three thousand visitors went through the show in the three hours of the demonstration.

An unusual feature of this Annual Show was the entertainment of the children from the Smouse Opportunity School of Des Moines, who came with their teachers to see how clayware products are made. These little folks, who have twisted bodies and can not attend the usual type of school, are doing a little pottery work and were guests of the Department.

GUY EUGENE STONG MAKES ASTONISHING RECORD

A Tribute Presented by Paul E. Cox

Guy Eugene Stong was graduated June 12 with the degree of Bachelor of Science from the Department of Ceramic Engineering of Iowa State College with the highest scholastic standing in the class of over 500 from the entire College.

His honors for high scholarship are as follows:

(1) Story County Alumni prize for the highest scholastic standing of any graduating student in the entire College.
(2) Sigma Xi prize to the Junior Student having the highest scholastic standing in the entire College.
(3) Phi Kappa Phi prize to the Sophomore student having the highest scholastic standing in the entire College.
(4) Tau Beta Pi prize to the Freshman student making the highest average in the Engineering Division.
(5) Pi Mu Epsilon prize to the student completing calculus with the highest average for the required two years of engineering mathematics.

Stong has been elected to Tau Beta Pi, Pi Mu Epsilon, and Phi Kappa Phi.

The curriculum in Ceramic Engineering specified 211 credit hours for the B.S. degree. During Stong's junior year a ruling was made allowing a student to classify for

a total of twenty-three hours rather than the usual limit of eighteen hours. Many students were restricted under this plan to less than eighteen hours. Stong carried twenty-three hours each quarter after this ruling was made, graduating with a total of 233 credits. These extra credits are in the field of differential equations and physics, work generally carried only by graduate students. His work in mathematics was so well done that a ruling of the Graduate Division prevented a recording of the fact that he had taken the course. He completed all the work available for undergraduates, and lacks but a few credits of having earned a major in mathematics as well as his degree in engineering.

Stong has but three grades below 90 in his four years of work, these in two credit shop courses. To offset these shop work grades (though not done with that intent), he worked in leisure time on the potter's wheel and, during one of the Open House shows, demonstrated the wheel to the visitors. His last quarter of calculus yielded a grade of 99; in differential equations his lowest grade was 96 and his highest, 98. He has had no grade lower than 94 in any subject involving the use or study of mathematics.

GUY EUGENE STONG

It is decidedly to his credit that in a course not demanding a modern language he elected a year of work in German and his grades in this work are like his mathematics grades.

Stong did all work equally well. While his tastes ran to mathematics his chemistry work was done just as well and earned the same high grades.

Stong always had time to help his fellow students with the tasks incident to the Open House shows, making the souvenir ware for the visitors, demonstrating the apparatus, or acting as a guide. He was always dependable for any labor job that others undertook.

During his four-year course he read more than 400 books not related to his college work. He had more books drawn against his name than any student of the entire College. These were fiction, philosophy, biography, art, and history. A good work on any of the crafts appealed to him.

Stong is modest and quiet. His fellows found by quizzing that he is a cousin of Phil Stong, author of a recent novel, State Fair. Two brothers who preceded him were students of distinction. Neither one got quite so many honors but one was seventh in the Engineering Division and the other was first in his own department and in the upper 3% of the entire College.

Had the present rule allowing a total of twenty-three credit hours for the student capable of the work been in effect for the four years, Guy Eugene Stong would have been a problem for the administration. His last year would have been nearly all in work not available to the undergraduate student and the sequence of undergraduate subjects would have prevented his graduation in three years. Rules made for ordinarily good students would have failed utterly in his case.

Stong chose the study of paving brick samples by X-ray examination using the powder method as his special problem. His hobby being photography, he has an interesting set of X-ray spectra of the products of many high-grade American paving brick producers. He has correlated these spectra with the rattler losses reported and while his work was that of a five-credit course only, he produced a set of photographs that should pave the way for additional work in the field of face brick and paving brick manufacture.

His home is in Kilbourne, Iowa. He plays tennis as a sport. He is a Democrat in politics. He is not a member of any social fraternity.

PROFESSIONAL DEGREE OF CERAMIC ENGINEER GRANTED AT OHIO STATE UNIVERSITY, JUNE, 1933

Lawrence Eugene Barringer, General Electric Co., Schenectady, N. Y.
George Herbert Brown, Ceramic Dept., Rutgers University, New Brunswick, N. J.
Charles Mitchener Dodd, Ceramic Dept., Missouri School of Mines and Metallurgy, Rolla, Mo.
Walter Austin Hull, Salem, Ohio.
Samuel John McDowell, A C Spark Plug Co., Flint, Mich.
Earle Towne Montgomery, Montgomery Porcelain Products Co., Franklin, Ohio.
George D. Morris, New Castle Refractories Co., New Castle, Pa.

AMERICAN PRODUCTS FOR THE WORLD'S FAIR

Every day brings added evidence that the products of American potteries are being accepted everywhere as at least the equal of anything that Europe has to offer.[1] Many prominent restaurants, which for years have used nothing but European-made chinaware, are changing over to products made in this country.

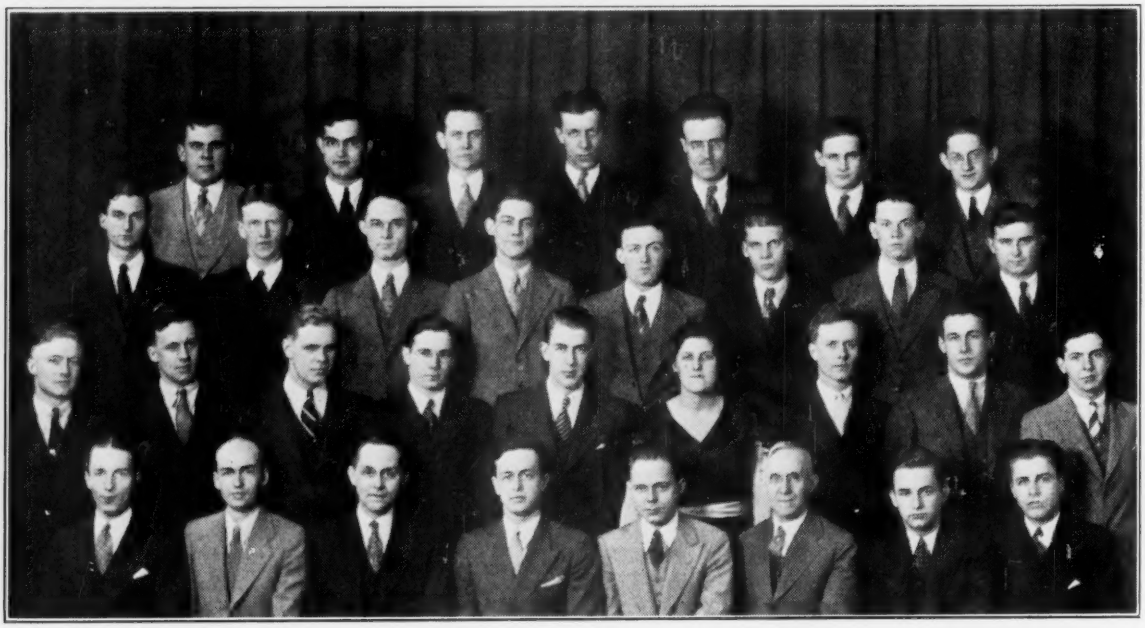
Albert Pick Co., Inc., the hotel and restaurant supply house of Chicago, report that they furnished only American made chinaware in the following restaurants at the Century of Progress:

Victor Vienna Restaurant
Spanish Pavilion
Casino de Alex
Streets of Paris
- Cafe de la Paix
- Cafe de Select
- Cafe Le Rotunde
- Fisher's Restaurant

Japanese Bldg. Restaurant
Triangle Restaurant
Rutledge Tavern
Administration Bldg. Grill
Harding's Restaurant
Belgian Village Restaurant
Days of '49 Bar and Restaurant

[1] For other concessions at the Century of Progress, see list published in *Bull. Amer. Ceram. Soc.*, **12** [6], 164 (1933).

OHIO STATE UNIVERSITY STUDENT BRANCH OF THE AMERICAN CERAMIC SOCIETY



Hugenot Cayford Latimer Cecil Peck Lanman Rea
Terry Robinson Reed Kaiser Stone Croskey P. Johnston Derrer
Slyh Buckley Gerdes Llewellyn Burlingame Gitter Cone R. Johnston Dorsey
Metzger P. Herold Martz J. Herold Constance Watts Tinsley Yeagley

MINIATURE GLASS PLANT AT THE CENTURY OF PROGRESS

Included in the exhibit of the Owens-Illinois Glass Company, of Toledo, in its glass-block building at the Century of Progress, Chicago, is an elaborate animated model of a complete glass plant in operation.

The machine and pot revolve and miniature bottles are carried by a conveyer into the leer, where they are seen through a cut-out section moving along toward the inspectors and packers.

Model glass plant at Century of Progress Exposition.

Mr. Ceramist—

We have { *The Clay*
The Facilities
The Experience

H. C. SPINKS CLAY COMPANY
NEWPORT, KY.

THREE ELEPHANT
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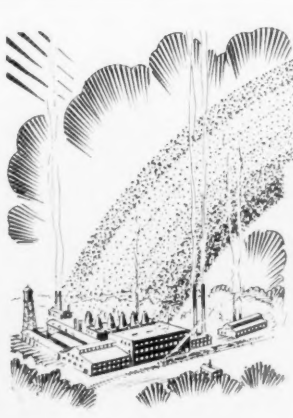

FOUND---THE POT OF GOLD AT THE END OF THE RAINBOW

"Ceramic colors" save money through dependability, strength and absolute purity of color, shade and tint.

Many years in providing the ceramic industry with all colors of the rainbow is your assurance of economy and results that retain satisfied customers of your ware.

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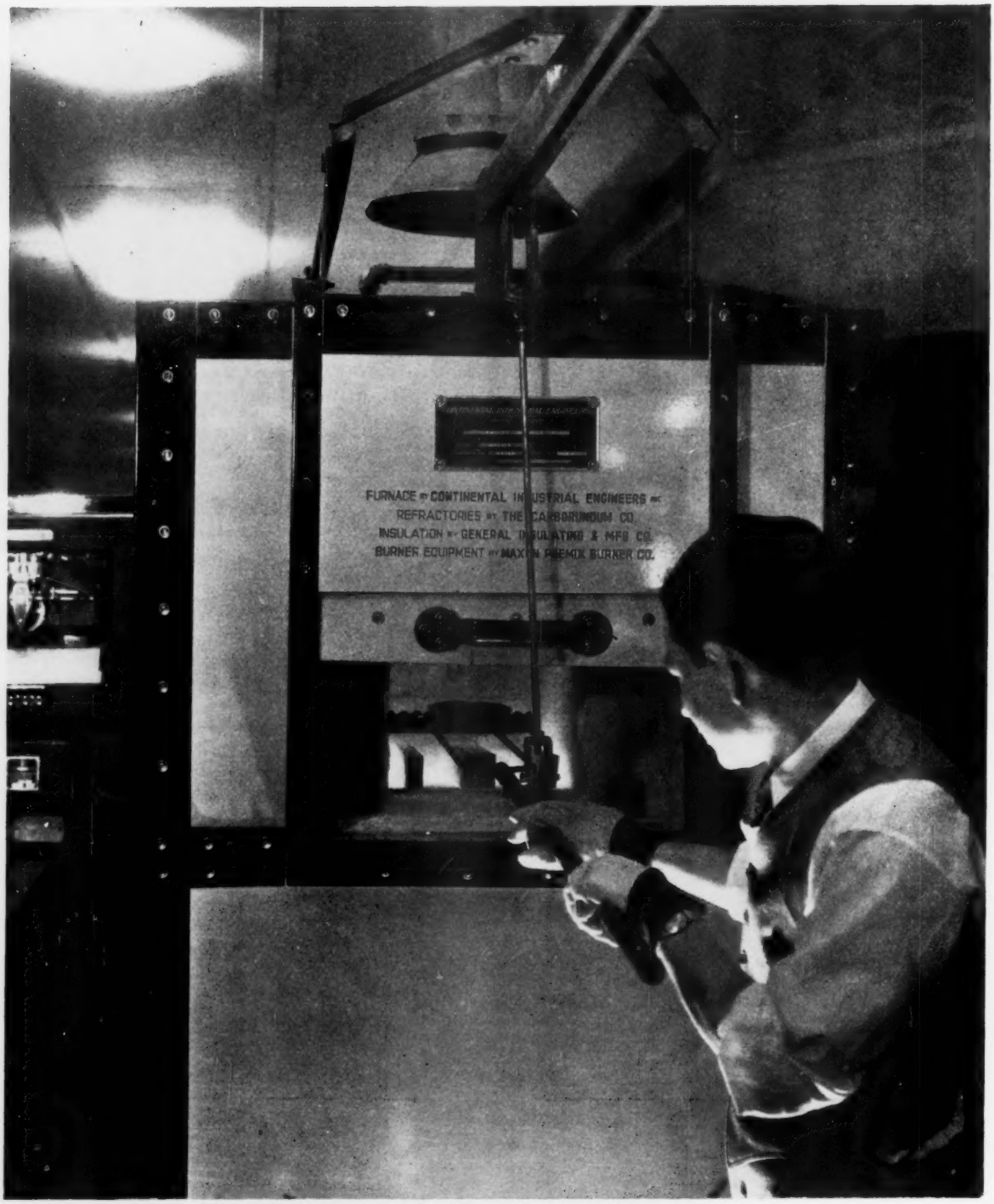
FURNACE BY CONTINENTAL INDUSTRIAL ENGINEERS
REFRACTORIES BY THE CARBORUNDUM CO.
INSULATION BY GENERAL INSULATING & MFG CO.
BURNER EQUIPMENT BY MAXON PREMIX BURNER CO.

Above—the furnace equipped with "Carbofrax" Muffle in operation in the model enameling plant.

Below—a glimpse of a section of the Porcelain Enamel Parade.

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◆ ◆ ◆

A "CARBOFRAX" MUFFLE

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We urge you to visit the miniature model enameling plant in operation in the Porcelain Enamel Institute's outstanding exhibit. See the furnace designed by Continental Industrial Engineers, Inc., and The Carborundum Company in actual operation.

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FINEST POTTERY CLAYS

BUYERS' GUIDE

A

Abrasives (Alundum-Crystolon)
Norton Co.

Aloxite (Refractory Products)
Carborundum Co.

Alumina (Hydrate and Calcined)
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Pennsylvania Salt Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Aluminum Oxide (Fused)
The Exolon Co.
The Vitro Mfg. Co.

Alundum (Refractory Products)
Norton Co.

Ammonium Bifluoride
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Ammonium Carbonate
Ceramic Color & Chemical Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Antimony Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

B

Ball Mills
McDanel Refractory Porcelain Co.

Ball Mills (Laboratory Type)
Ceramic Color & Chemical Mfg. Co.

Barium Carbonate
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Batts
Carborundum Co. (*"Carbofrax Aloxite"*)
Norton Co. (*Alundum Crystolon*)

Bitstone
Potters Supply Co.

Blocks (Refractory)
Carborundum Co.
Norton Co.

Borax
American Potash & Chemical Co.
Drakenfeld & Co., B. F.
Pacific Coast Borax Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Borax Glass
Pacific Coast Borax Co.

Boric Acid (Anhydrous)
Pacific Coast Borax Co.
The Vitro Mfg. Co.

Boric Acid (Crystal, Granular, or Powder)
American Potash & Chemical Co.
Drakenfeld & Co., B. F.
Pacific Coast Borax Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Bricks (Refractory)
Carborundum Co. (*"Carbofrax Aloxite"*)
Norton Co.

C

Carbofrax (Refractory Products)
Carborundum Co.

Carbolon (Refractory Products)
The Exolon Co.

Carbonates (Barium, Lead)
Ceramic Color & Chemical Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Caustic Soda
Ceramic Color & Chemical Mfg. Co.
Pennsylvania Salt Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Cements
Carborundum Co.

Ceramic Chemicals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Chromium Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

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Edgar Brothers Co.
Hammill & Gillespie, Inc.
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Kentucky-Tennessee Clay Co.
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Spinks Clay Co., H. C.
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Clay (Sagger)
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Kentucky-Tennessee Clay Co.
Paper Makers Importing Co.
Potters Supply Co.
Spinks Clay Co., H. C.

Clay (Wad)
Kentucky-Tennessee Clay Co.
Potters Supply Co.
Spinks Clay Co., H. C.

Clay (Wall Tile)
Kentucky-Tennessee Clay Co.
Paper Makers Importing Co.
Spinks Clay Co., H. C.

Clocks (Gauge Board)
Ferro Enamel Corp.

Cobalt Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Colors
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Cornwall Stone
Hammill & Gillespie, Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Cornwall Stone (Imported)
The Roessler & Hasslacher Chemical Co.

Crucibles (Filter, Melting, Ignition)
Norton Co.
Potters Supply Co.

Crystolon (Refractory Products)
Norton Co.

D

Decorating Supplies
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Drying Machinery
Ferro Enamel Corp.

E

Electrical Porcelain
Paper Makers Importing Co.

Enameling Equipment (Complete)
Chicago Vitreous Enamel Products Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.

Enameling Furnaces
Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Norton Co.
Porcelain Enamel & Mfg. Co.

Enameling Iron (Sheet)
American Rolling Mill Co.

Enameling Muffles
Carborundum Co. (*Carbofrax*)
Norton Co. (*Alundum*)

Enameling (Practical Service)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.

Enamels
Ceramic Color & Chemical Mfg. Co.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Enamels (Porcelain)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.

Equipment (Porcelain Enameling)
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.

Exolon (Refractory Products)
The Exolon Co.

BUYERS' GUIDE (continued)

F

Feldspar
Ceramic Color & Chemical Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Fire Brick
Carborundum Co.
Norton Co.

Flint
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Flint Pebbles
Ferro Enamel Corp.

Floors (Non-Slip)
Norton Co.

French Flint
Paper Makers Importing Co.

Frit
Ceramic Color & Chemical Mfg. Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.

Furnace
Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.

G

Glaze and Body Spar
Ceramic Color & Chemical Mfg. Co.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Glazes and Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Glaze Spar
Ceramic Color & Chemical Mfg. Co.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Gold
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Grinding Wheels
Norton Co. (*Alundum Crystolon*)

H

Hearths
Carborundum Co.
(*Carbofrax* heat treating)
Norton Co. (*Crystolon*)

Hearths (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Norton Co.

I

Iron (Enameling)
American Rolling Mill Co.

K

Kaolin
Ceramic Color & Chemical Mfg. Co.
Edgar Brothers Co.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Kilns (China, Decorating)
Drakenfeld & Co., B. F.

Kryolith
Pennsylvania Salt Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

L

Leeds (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.

Linings (Furnace Refractory, Block Refractory Plate, Brick and Tile)
Carborundum Co.
Norton Co.

M

Magnesia (Sintered, Calcined)
The Exolon Co.
Norton Co.

Magnesite
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Manganese
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Metals (Porcelain Enameling)
American Rolling Mill Co.

Minerals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Muffles (Furnace)
Ferro Enamel Corp.
Carborundum Co. (*Carbofrax*)
Norton Co.

Mullite (Artificial)
The Exolon Co.

Muriatic Acid
Pennsylvania Salt Mfg. Co.

N

Nitrates (Cobalt, Sodium)
Ceramic Color & Chemical Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

O

Opacifiers
Ceramic Color & Chemical Mfg. Co.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Oxides
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Drakenfeld & Co., B. F.
Ferro Enamel Corp.
Metal & Thermit Corp.
Pennsylvania Salt Mfg. Co.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

P

Pins
Potters Supply Co.

Porcelain Enameling Service (Practical)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.

Porcelain Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.

Potash (Carbonate)
Ceramic Color & Chemical Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Pyrometer Tubes (Refractory and Hard Porcelain)
McDanel Refractory Porcelain Co.

R

Refractories
Carborundum Co.
The Exolon Co.
Norton Co.

Refractory Materials
Carborundum Co.
The Exolon Co.
Norton Co.

Rutile
Ceramic Color & Chemical Mfg. Co.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

S

Saggers
Carborundum Co.
Norton Co.
Potters Supply Co.

Selenite of Sodium
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The Vitro Mfg. Co.

Selenium
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Sheets (Enameling Iron)
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Silica (Fused)
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Silicate of Soda
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Philadelphia Quartz Co.
The Vitro Mfg. Co.

Silicon Carbide
The Exolon Co.
Norton Co.

Silicon Carbide Firesand
The Exolon Co.

Sillimanite (Synthetic)
The Exolon Co.

Slabs (Furnace)
Carborundum Co.
Norton Co.

Smelters
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.

Soda Ash
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The Vitro Mfg. Co.

Sodium Antimonate
Ceramic Color & Chemical Mfg. Co.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Sodium Fluoride
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Spar
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Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Spurs
Potters Supply Co.

Stilts
Potters Supply Co.

Sulphuric Acid
Drakenfeld & Co., B. F.
Pennsylvania Salt Mfg. Co.

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T

Talc
Hammill & Gillespie, Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.

Tanks (Pickle)
Ferro Enamel Corp.

Tile (Refractory)
Carborundum Co. (*Carbofrax*)
Norton Co.

Tile (Wall)
Ferro Enamel Corp.
Paper Makers Importing Co.

Tin Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Titanium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Titanium Oxide
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Tubes (Insulating)
McDanel Refractory Porcelain Co.
Norton Co.

Tubes (Pyrometer)
McDanel Refractory Porcelain Co.
Norton Co.

W

Wet Enamel
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.

Whiting
Drakenfeld & Co., B. F.
The Roessler & Hasslacher Chemical Co.

Z

Zirconia
Ceramic Color & Chemical Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

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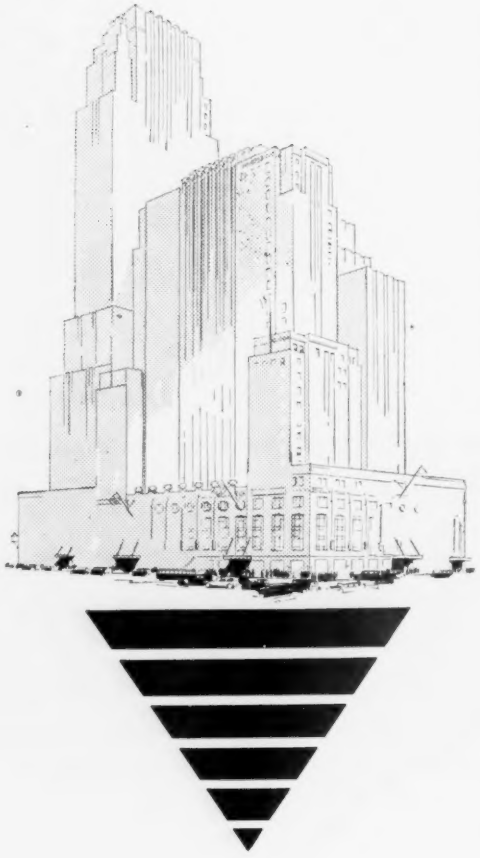

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